

***Cladopus javanicus* (Podostemaceae), a New Species from Java**MASAHIRO KATO¹ and GREGORI G. HAMBALI²¹*Department of Biological Sciences, Graduate School of Science, University of Tokyo, 7-3-1 Hongo, Tokyo 113-0033, Japan;* ²*Yatazawa Tropical Plant Research and Development Gardens, 7 Arca Domas St., Baranangsiang Indah, Bogor 16710, Indonesia*

A new species of Podostemaceae, *Cladopus javanicus*, is described from West Java. It is a second Malesian species of *Cladopus* and differs from the other congeneric species including *Cladopus nymanii* and *Torrenticola queenslandica* in the long shoots and densely imbricate digitate leaves.

Key words: *Cladopus javanicus* sp. nov., Java, Podostemaceae, taxonomy, *Torrenticola*.

In a revision of Malesian Podostemaceae, van Steenis (1949) recorded *Cladopus nymanii* H. Möller from Java and southwestern Celebes (Sulawesi) and *Torrenticola queenslandica* Domin from southeastern New Guinea, which is also distributed in northeastern Australia. Later the distribution range of *C. nymanii* was extended to northern East Kalimantan (Borneo) by a recent collection (van Steenis 1989; see also Cusset 1992). From Malay Peninsula Dransfield & Whitmore (1970) described *Indotristicha malayana* J. Dransf. & Whitmore (van Steenis 1972), which was later transferred to the monotypic genus *Malaccotristicha* by Cusset & Cusset (1988). Totally three species are known in Malesia so far.

In the genus *Cladopus* emended, Cusset (1992) recognized four species, *C. nymanii*, *C. taiensis* C. Cusset, *C. hookerianus* (Tul.) C. Cusset, and *C. pierrei* (Lecomte) C. Cusset. *Cladopus nymanii* was considered as a widely distributed and morphologically variable species including as synonyms *C. doianus* (Koidz.) Koriba, *C. japonicus* Imamura, and *C.*

austrosatsumensis (Koidz.) Ohwi from southern Japan, *C. chinensis* (H.-C. Chao) H.-C. Chao and *C. fukiensis* (H.-C. Chao) H.-C. Chao from Southeast China, *C. warmingiana* Koidz. from Java, and *C. fallax* C. Cusset from Vietnam. Kadono (1994), Kadono & Usui (1995), Nakayama & Minamitani (1999), and other Japanese botanists (e.g., Koidzumi 1935; Shin 1982; Ohwi 1984) regarded the three Japanese species and the recently described *C. austrosatsumensis* Kadono & N. Usui as independent species, and Chao (1948, 1980) separated the Chinese species from *C. nymanii*. This splitting treatment was supported by a recent molecular phylogenetic analysis (Y. Kita, unpublished data). *Cladopus hookerianus* from southern India and *C. pierrei* from Laos and Vietnam were assigned to sect. *Griffithella* (Cusset 1992), which was treated as the genus *Griffithella* by other authors (e.g., Mathew & Satheesh 1997). *Cladopus hookerianus* (= *Griffithella hookeriana*) differs from the other congeneric species in the simple, non-digitate leaves on the flowering shoots and two stamens and is

geographically isolated.

During field surveys in West Java, one of us (G. G. H.) found a species assignable to *Cladopus* in Curug Luhur Waterfalls, in which various-sized plants occur together, and in another locality. Extremely small plants of the species look like *C. nymanii* but differ from it in their vegetative and flower characters, while all other plants have as long shoots as *Torrenticola queenslandica*, from which they differ in the leaf and fruit characters, as noted below. Recently we revisited the localities and others to collect material for morphological and phylogenetic analyses. Molecular phylogenetic analyses using the *matK* gene showed that in nucleotide sequences materials from extremely small and large plants differ from *C. nymanii* (sensu stricto) more greatly than *T. queenslandica* differs from *C. nymanii*, while both materials have the same sequence (Kita & Kato 2001; Y. Kita, unpublished data). These morphological and molecular differences seem to warrant recognition of a new species, *C. javanicus*. The molecular phylogeny of *C. javanicus* and other species will be published elsewhere by Y. Kita.

Cladopus javanicus M. Kato & Hambali, sp. nov. (Figs. 1-3)

Ab *C. nymanii* caulibus longis et ab *Torrenticola queenslandica* foliis digitatis, imbricatis, fructibus laevibus (non-costatis) differt.

Type. M. Kato, R. Imaichi, C. Tsutsumi & G. G. Hambali ID-105, July 31, 2001 (BO; isotype TI), West Java, Curug Luhur Waterfalls, Cikaso River, Cisagu, Sagaranten, 300 m alt., 7°14'S 106°49'E; growing on water-worn rock surface in waterfalls in open place.

Roots ribbon-shaped, creeping, adhering to rocks, 2-4 mm wide, branched with lateral roots, bearing shoots on dorsal surface at

junction of main and lateral roots (Fig. 3A). Shoots simple, usually up to 5 cm long, sometimes up to 7(-10) cm long, ca. 3 mm thick including leaves, somewhat narrowed to base; leaves falcate at base, distichous, densely imbricate, more than 60 in long shoots (fewer in short shoots), moderately rough on the surface, digitate with 4-7 lobes, 2-3 mm long with lobes simple or forked, 1-2 mm long; lobes of leaves at sterile stem tip filiform, much longer than those below, up to 5 mm long or longer, leaves at flowering stem tip conform to lower ones with lobes 1-2 mm long. Flowers single at shoot apex; spathe covering flower buds, globular-ellipsoidal, pointed at apex, ruptured irregularly at or near tip at anthesis; peduncles 3-4 mm long; tepals two on both sides of stamens, linear, ca. 0.5 mm long; stamens one with simple filaments, more often two or rarely three with filaments branched at or above base of filaments (Fig. 2), 1.5-2.8 mm long, as long as or a little longer than ovaries; ovaries globular-ellipsoid, 2-3 mm long, 1.5-2.0 mm thick, shallowly grooved in somewhat obliquely vertical lines, 2-locular; septae convex on both sides, ca. 0.7 mm thick, thin-margined (Fig. 3C); ovules 35-40 in the smaller locule, 50-55 in the larger locule, thus nearly 100 per ovary, dense over septa (Fig. 3B, C); stigma ascending or sometimes erect, bilobed, lobes ligulate, equal-sized, 1.0-1.5 mm long. Fruit-stalks slender, up to 6 mm long; capsules chestnut-brown, globular-ellipsoid, as large as ovaries, smooth except for two oblique grooves, rupturing into two unequal valves, larger valve persistent. Flowering and fruiting in July-September.

Other specimens examined. *G. G. Hambali s.n.* Aug. 28, 1978 (BO), *Kato et al. ID-1* (BO, TI), Curug Luhur Waterfalls, Cikaso River, Cisagu, Sagaranten; *Kato et al. ID-4*, *Kato et al. ID-101* (BO, TI), Ciliwung River, Kadok, east of Ciawi, on a cemented dam and nearby rocks,

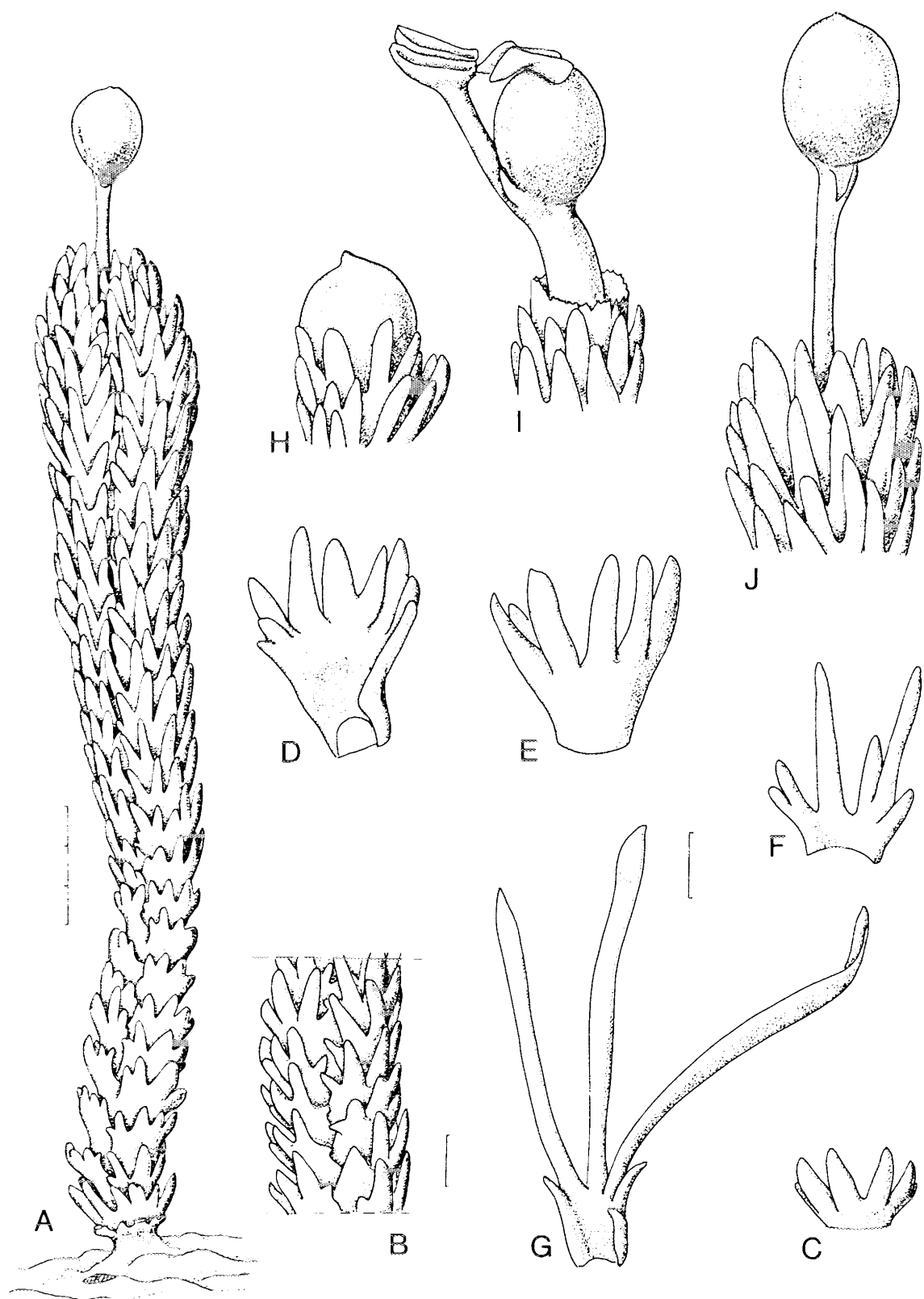


FIG. 1. *Cladopus javanicus*. (Kato *et al.* ID-1). A. Fruiting shoot on root. B. Portion of shoot with alternate leaves in two rows. C-G. Leaves; C, small leaf at the base of shoot; D, E, adaxial and abaxial views of leaves on the upper part; F, leaf with unequally long lobes; G, leaf with some lobes markedly long on the upper part of vegetative shoot. H. Flower bud covered by spathe with pointed apex. I. Flower with single stamen and ruptured spathe at the base of stalk. J. Fruit. Scale bars = 3 mm in A, 1 mm in B, G (applied for C-G) and J (for H-J).

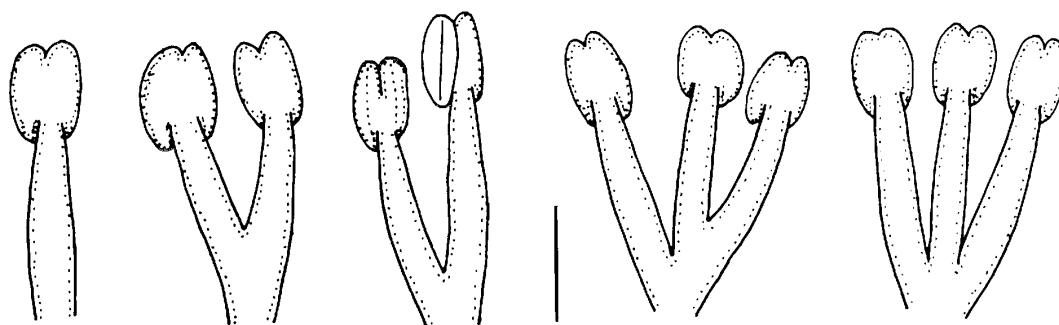


FIG. 2. Illustrations of stamens of *Cladopus javanicus* viewed from dorsal side (Kato *et al.* ID-105). Scale bar = 1 mm.

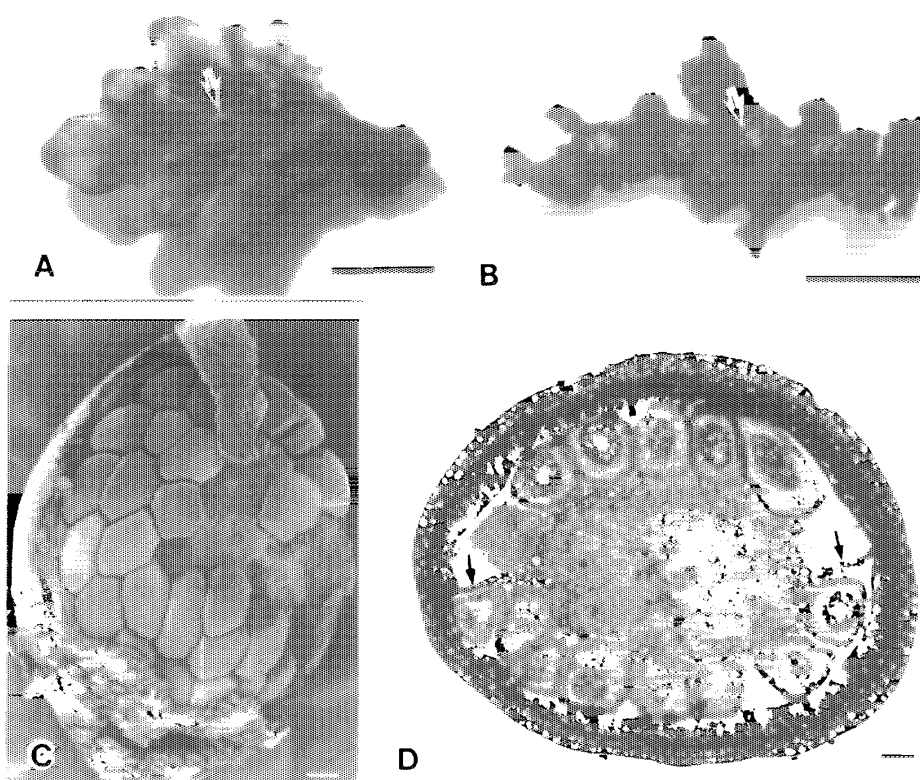


FIG. 3. *Cladopus javanicus* (Kato *et al.* ID-105). A, B. Surface views of roots (A, young; B, mature) with shoots (arrows) on dorsal side near the junction of lateral branches. C. SEM micrograph of ovules borne over septum in ovary whose wall is partly removed. Some ovules are removed. D. Transverse section of 2-locular ovary. A thin margin of septum is marked by arrows. SEM and anatomical techniques followed Ota *et al.* (2001), except for using a JEOL JSM-820S microscope. Scale bars = 5 mm in A and B, 100 μ m in C and D.

450 m alt., 6°39' S 106°52'E.

Note. *Cladopus javanicus* is variable in the length of shoots. Large plants, which usually grow on rocks in streams, have long shoots, as described above. Small plants, which grow on rocks near water falling and at the edge of

streams in Curug Luhur Waterfalls, have short flowering shoots. Although similar to *C. nymanii*, the small plants are not an ecological variant of the species but dwarf or young plants of *C. javanicus*. It is also supported by a molecular phylogeny, as noted above (Y. Kita,

unpublished data).

Cladopus javanicus is similar to *C. nymanii* in the digitate leaves and smooth fruits, but differs from it not only in the long shoots but also in the moderately rough leaf surface, one or two (rarely three) stamens, which are nearly as long as ovaries, and larger ovaries (capsules) with a larger number of ovules. In *C. nymanii* the roots are up to 5 mm wide (for populations at the type locality we recently visited), the digitate leaves distinctly rough on the surface, the flowering shoots up to 1 cm long, the stamens single, the filaments up to 2.5 mm long (longer than ovaries), the ovaries (capsules) 1-2 mm long and ca. 1 mm thick, with ovules up to 50 per ovary (see also Möller 1899). *Cladopus warmingiana* based on Warming's (1901) description and illustrations (type: *H. Jensen s.n.*, Cikante, West Java, which is the same as the type locality of *C. nymanii*) is already synonymized under *C. nymanii* (Cusset 1992).

van Steenis (1949) pointed out similarities of *Torrenticola queenslandica* and *Cladopus nymanii* in the pointed spathe and other flower structures. *Cladopus javanicus* is very similar to *T. queenslandica* in the long shoots and nearly as long stamens as ovaries, but differs from it in the densely imbricate, digitate leaves and smooth fruits. In *T. queenslandica* the leaves are not densely imbricate with decurrent bases, 3-4-toothed with a central tooth of sterile plants filiform and up to 25 mm long, and the fruits are 10-ribbed. Although *C. javanicus* is morphologically more similar to *T. queenslandica* than to *C. nymanii*, a molecular phylogeny shows that *C. javanicus* is sister to a group of *C. nymanii* and *T. queenslandica* (Y. Kita, unpublished data). Furthermore, these three Malesian (also Australian) species are sister to Thai *C. taiensis*, and this Malesian-Australian clade is sister to the other clade consisting of Japanese and Chinese species of

Cladopus (Kita & Kato 2001; Y. Kita, unpublished data). Because *T. queenslandica* is nested within the *Cladopus* clade (Kita & Kato 2001), a nomenclatural revision is required.

Cladopus javanicus has been collected at only a few localities in West Java so far, but it may be possible that it is more widely distributed. *Cladopus nymanii* is widely distributed in Java, southwestern Celebes (Sulawesi), and northern East Kalimantan (van Steenis 1936, 1949, 1989). It is also recorded from Hainan Island and Hongkong, Southeast China (Chun & Tsiang 1963; Cusset 1992). A question of whether some local populations assigned to *C. nymanii* are independent species needs further field survey and experimental analysis. A molecular phylogeny indicates that there are at least two species groups in eastern Asian *Cladopus* belonging to the other clade different from *C. nymanii*; one group consists of *C. doianus*, *C. japonicus*, *C. austrosatsumensis*, and *C. chinensis*, and the other of *C. austrosiumensis* and *C. fukiensis* (Y. Kita, unpublished data). However, it is uncertain whether all Japanese and Chinese species are regarded as independent species.

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